



Empowering Local Electricity Markets

A survey study from
Switzerland, Norway, Spain
and Germany



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Glossary

CH	Switzerland
DE	Germany
E-Bike	Electric Bike
ES	Spain
EV	Electric Vehicle
NO	Norway
PV	Photovoltaic system

Introduction

Greater integration of renewable energy sources constitutes a key priority for successfully achieving agreed-upon climate goal targets. Nuclear phase out, decentralization of supply, liberalization, digital technological innovations, and the sharing economy are only some of the key issues that the energy industry is facing in the coming decade.

Notwithstanding some of the associated challenges, a number of tremendous opportunities are also arising, and success can be achieved by introducing radically new business models. We are entering a period of so-called 'platform revolution': Platforms connect buyers and sellers in a virtual marketplace. Given the successful growth of platforms like Uber and Airbnb, it is difficult to ignore their disruptive potential for incumbent industries.

This study uncovers the drivers of and barriers to developing platform solutions in the electricity market, notably 'local electricity markets'. In local electricity markets, customers are empowered. They are connected through platforms. They actively participate in the marketplace by selling excess electricity that is produced locally using their own renewable sources, and by buying electricity that is locally produced. Consumers thus have the opportunity not only to consume, but also to produce electricity and to sell it in local markets, thereby, becoming prosumers!

Local electricity markets constitute one of the most radical transformations, as they involve integrating renewable energy and selling it at the source. The agenda for empowering consumers and prosumers in such a local marketplace is long and challenging. It requires an adjustment of product and service offerings to better reflect existing and prospective consumer and prosumer needs.

Putting existing and prospective consumers and prosumers center-stage is a critical step, if local electricity markets are to be a successful, forward-looking and sustainable solution. We firmly believe that the insights gained from this survey - which was conducted in four countries (Switzerland, Norway, Spain and Germany) - can be shared and acted upon by industry participants, consultants and citizens.

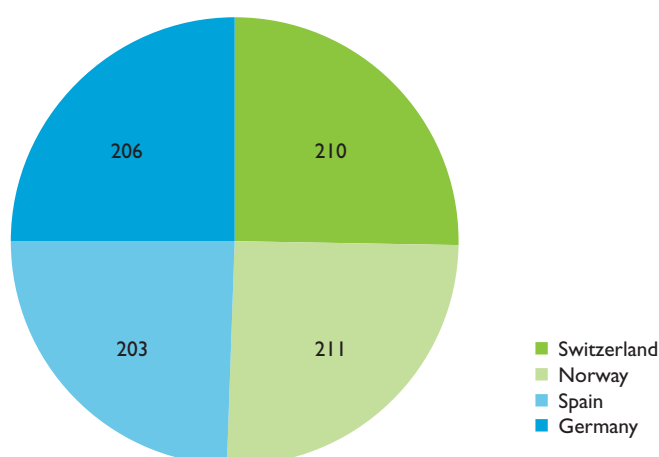
Special thanks go to our project partners Trine Wildt Andersen and Håkon Duus at Smart Innovation Norway, to Monica Aragues at Citcea, Julia Cousse and Doris Hoevel at the University of St. Gallen for their help with translations and/or data analysis, to Celina Wagner at misigno graphic-design for the graphical design and layout, and to the teams at respondi AG and Norstat for their help with data collection. The study was conducted by team members of the University of St. Gallen's Good Energies Chair for Management of renewable energies, within the scope of the EU Horizon 2020 EMPOWER project (www.empowerh2020.eu).

Dr. oec. Emmanuelle Reuter

Prof. Dr. Moritz Look

Methodology

The results presented in this study are based on a survey that was conducted in four countries, and with a representative sample of respondents, as follows: in Switzerland (total respondents: 210, of which 99 female and 111 male); in Norway (total respondents: 211, of which 118 female and 93 male); in Spain (total respondents: 203, of which 103 female and 100 male); in Germany (total respondents: 206, of which 119 female and 87 male).



Survey with 830 respondents from four countries.

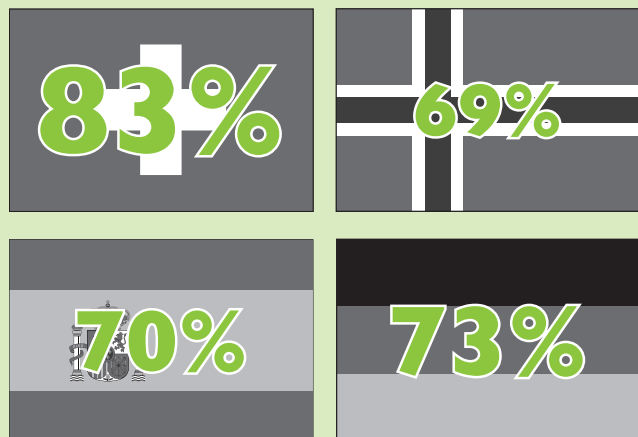
Data were collected between May 2017 and June 2017 by respondi AG in Switzerland, Spain, and Germany, and by Norstat in Norway. The data are balanced across the four countries; they are representative of gender (53% female respondents), and of living area (rural 39%; sub-urban 32%; urban 29%). Respondents are at least co-responsible for the financial concerns of the household.

A survey sample constitutes a snapshot of the total population at a selected point in time. It is important to note that the sample of respondents of this study may be considered representative in some key dimensions, as highlighted previously, but may be considered over- / underrepresented in others. For instance, the sample of respondents selected for this study met at least one of four conditions: 1. They owned a renewable energy installation (e.g. solar panel, heat pump, wind, biomass, battery), 2. they owned an electric vehicle, 3. they had gathered information about at least one renewable energy installation within the last 12 months, 4. they had gathered information about electric vehicles within the last 12 months. For this reason, the respondents may be considered to be rather familiar with themes related to renewable energy and / or electric vehicles.

Furthermore, 88% of the respondents own at least a flat or a house (95% in Germany; 94% in Switzerland; 84% in Norway and 80% in Spain). The average age of the respondents is 36 years (34 years in Germany; 37 years in Switzerland; 33 years in Norway; 40 years in Spain). That is, the sample incorporates a slightly older population from Spain. However, the analyses (as reported here) did not show any significant differences according to age.

In terms of the analyses, while there exist alternative ways of analyzing data (e.g. weighted average), we have consistently reported the percentage of respondents who stated they were in favor of (or against) the stated propositions.

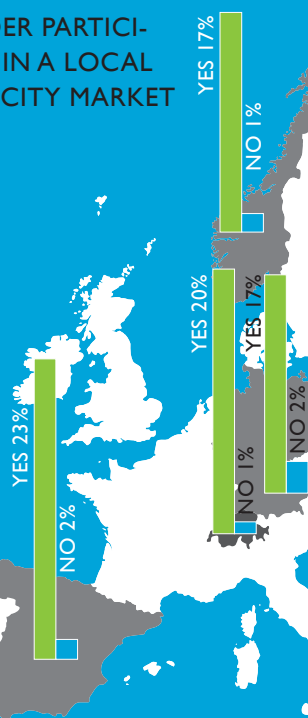
SELLING ELECTRICITY



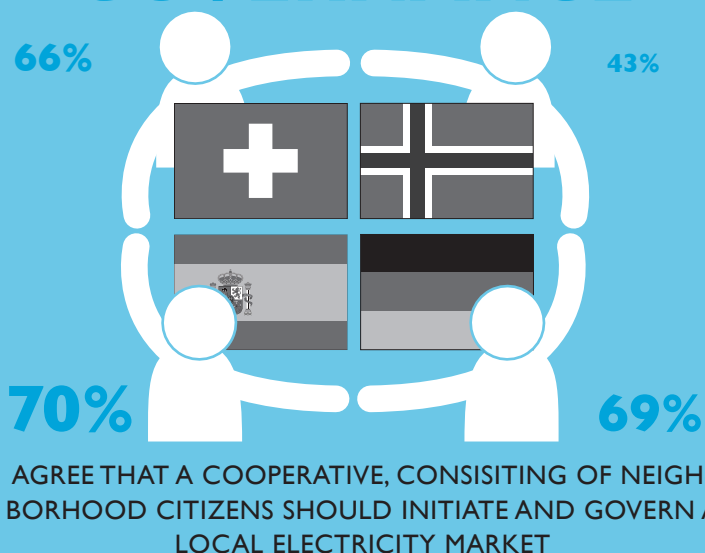
ARE WILLING TO SELL THEIR EXCESS ELECTRICITY

PARTICIPATION

CONSIDER PARTICIPATION IN A LOCAL ELECTRICITY MARKET



GOVERNANCE

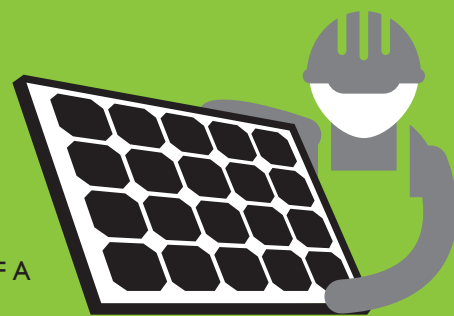


SERVICES

SERVICES WITH THE HIGHEST WILLINGNESS TO PAY

55%

INSTALLATION & MAINTENANCE OF A SOLAR PANEL



48%

INSTALLATION & MAINTENANCE OF A BATTERY



47%

INSTALLATION & MAINTENANCE OF SMART TECHNOLOGY



45%

BILLING & ACCOUNT MANAGEMENT OF THE EXCESS ELECTRICITY SOLD/SHARED

45%

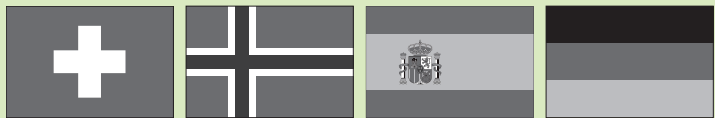
INSTALLATION & MAINTENANCE OF A HEAT PUMP



KEY DRIVERS OF PARTICIPATION



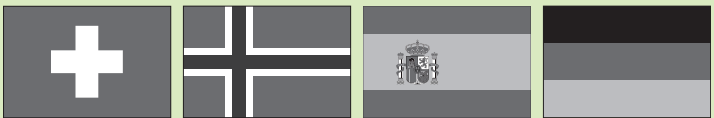
82% 70% 79% 79%



ENVIRONMENTAL

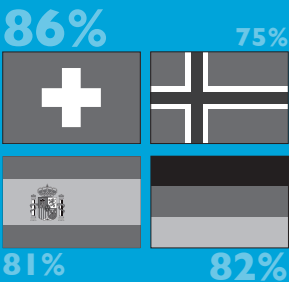
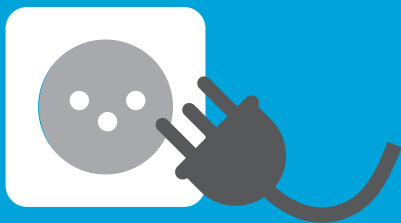


79% 66% 77% 76%

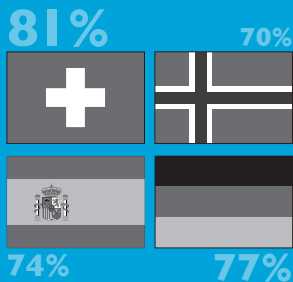


ECONOMIC

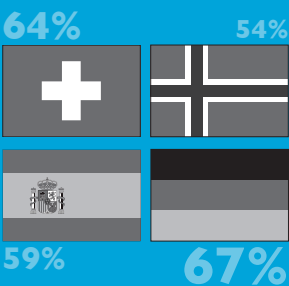
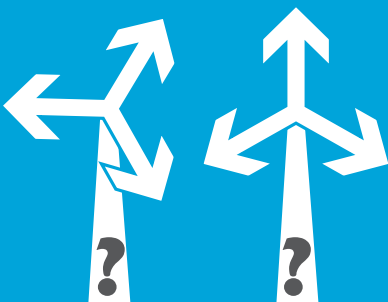
PRIORITY RISKS



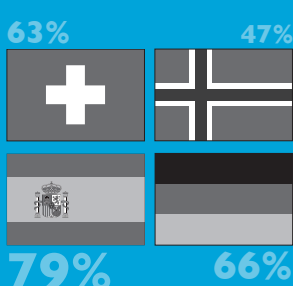
SECURITY OF ENERGY SUPPLY



BUREAUCRACY

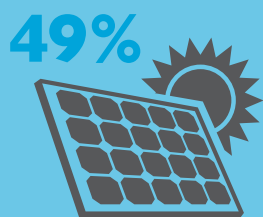


COORDINATION AMONG PARTICIPANTS

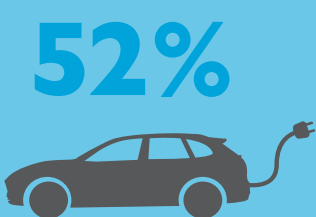


DATA PRIVACY

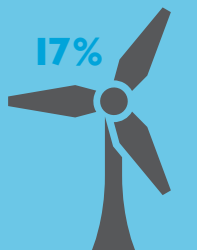
INFORMATION GATHERING BY TECHNOLOGY



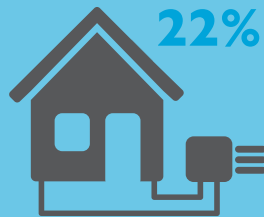
gathered information on solar panel



gathered information on electric vehicle



gathered information on wind installations



gathered information on heat pump

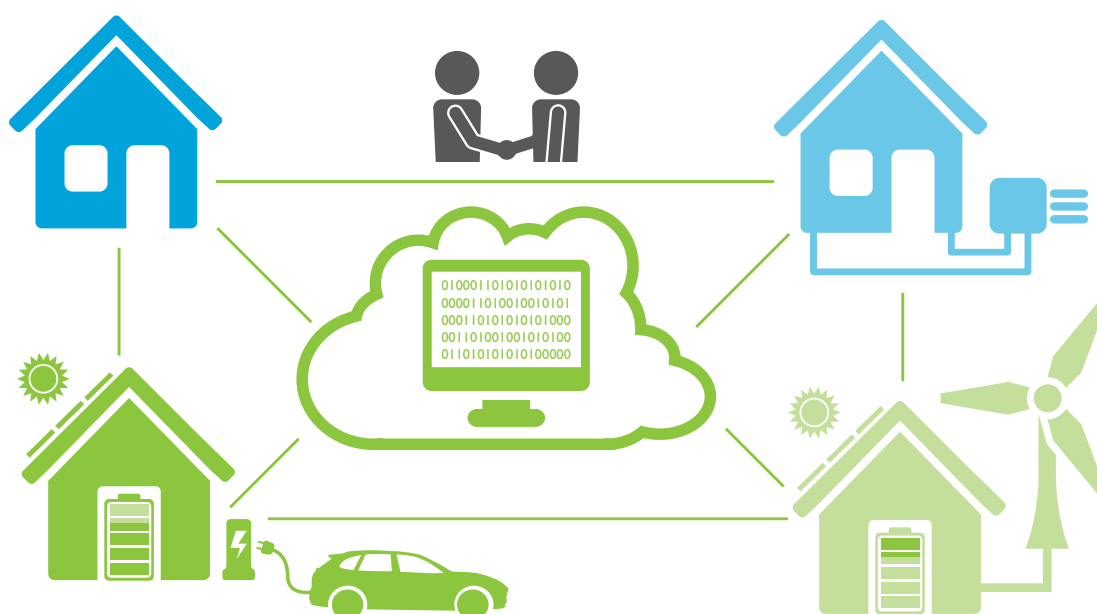
Participation in Local Electricity Markets

Local Electricity Markets

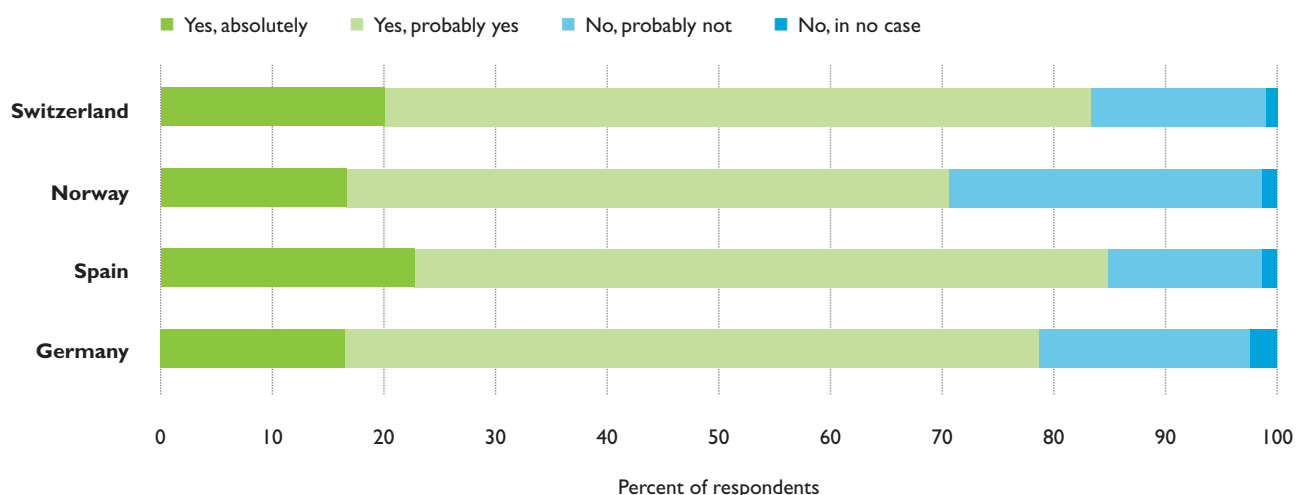
A local electricity market is a virtual/ an online marketplace, in which excess electricity (that is produced locally – in the neighborhood/ community – and from renewable sources – wind, sun, water), is distributed, shared and traded among neighbors. It constitutes a form of peer-to-peer energy trading (or sharing). Private citizens have the opportunity to buy locally-produced electricity directly from the marketplace and to sell excess electricity in the marketplace.

Further information is accessible through the following video links

<https://www.youtube.com/watch?v=zO07tNSH6Tw> and www.empowerh2020.eu



Willingness to participate in a local electricity market

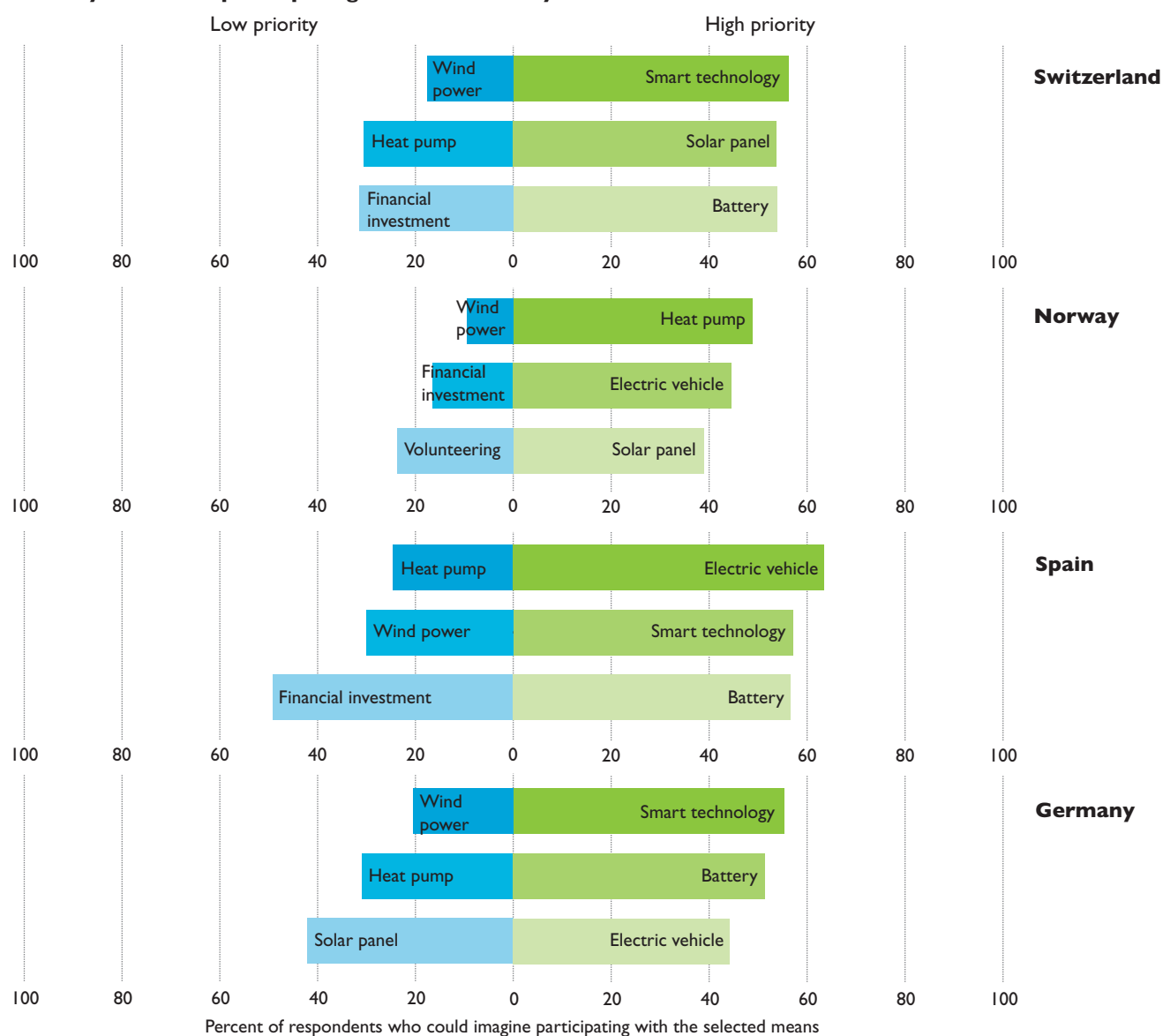


Key insights

- In sum, 79% of all respondents are rather favorable about prospective participation in a local electricity market, compared to 21% that are not.
- There are no significant differences in responses across countries.

Means of Participation in Local Electricity Markets

Priority means for participating in local electricity markets

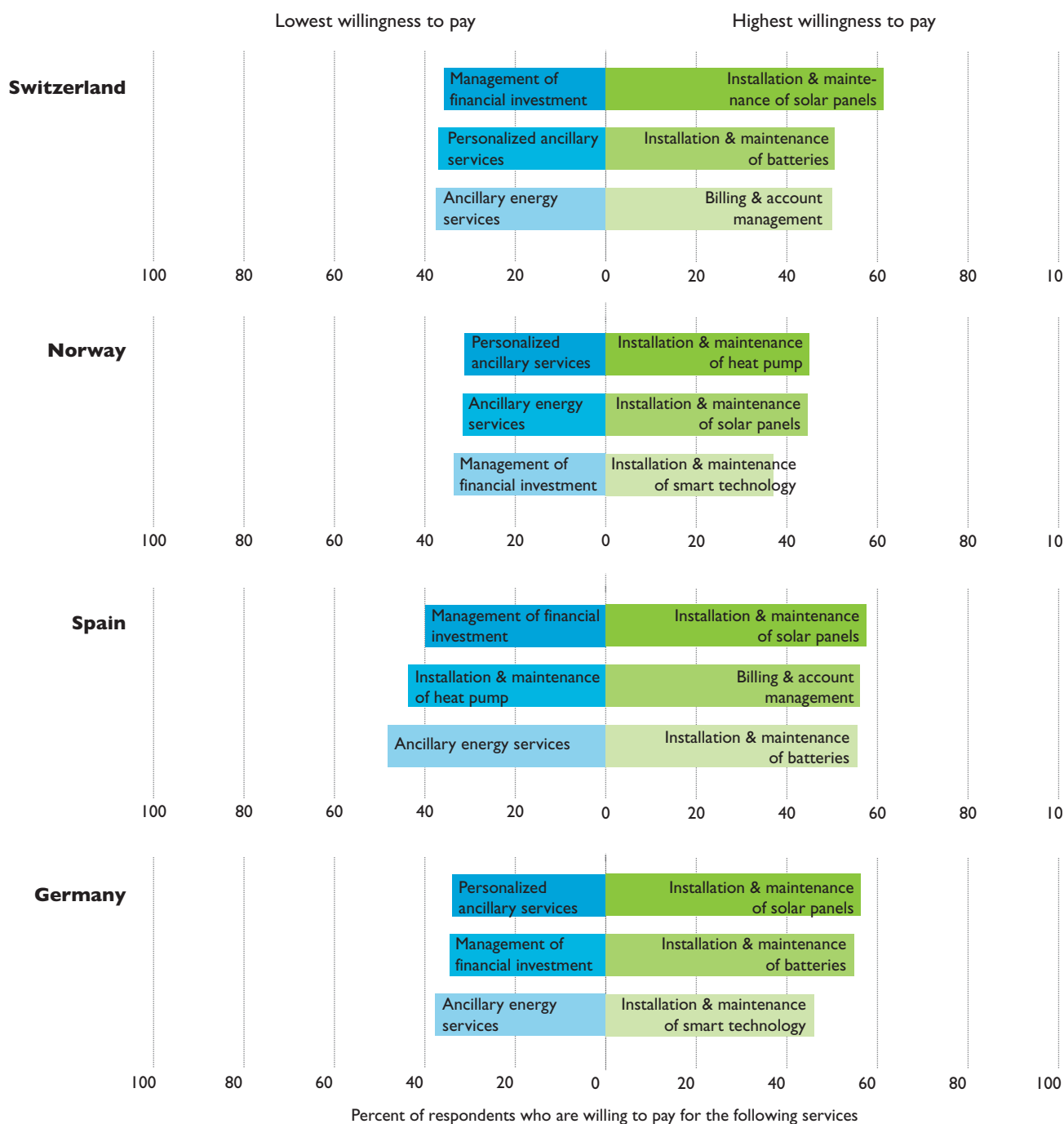


Key insights

- Smart technology, electric vehicles and batteries constitute the priority means for participating in local electricity markets for respondents from Switzerland, Spain and Germany. Respondents from Switzerland also consider solar panels, and respondents from Norway heat pumps, as priority means.
- Wind power stations, heat pumps and financial investment in local electricity projects in general (compared to financial investment in local electricity projects in the neighborhood) are considered among the lowest priorities.
- Differences in respondents' preferences across countries may be explained by differences in climatic conditions, in the ownership situation, in age, and in the local incentives and support for one particular technology. Respondents from Spain have a particularly low rate of ownership (80%), compared to the other countries, which may explain the high interest in electric vehicles and smart technology compared to other technologies. Overall, the interest in smart technology is rather high. This may be explained by the age of the surveyed population (average age: 36 years).
- Overall, the interest in smart technology is rather high, which may be explained by the age of the surveyed population (average age: 36 years).
- Regarding financial investment in local electricity projects, there is a clear preference for projects that take place in the neighborhood, rather than such projects in general.

Services in Local Electricity Markets and Willingness to Pay

Priority services for which respondents are (not) willing to pay a service fee

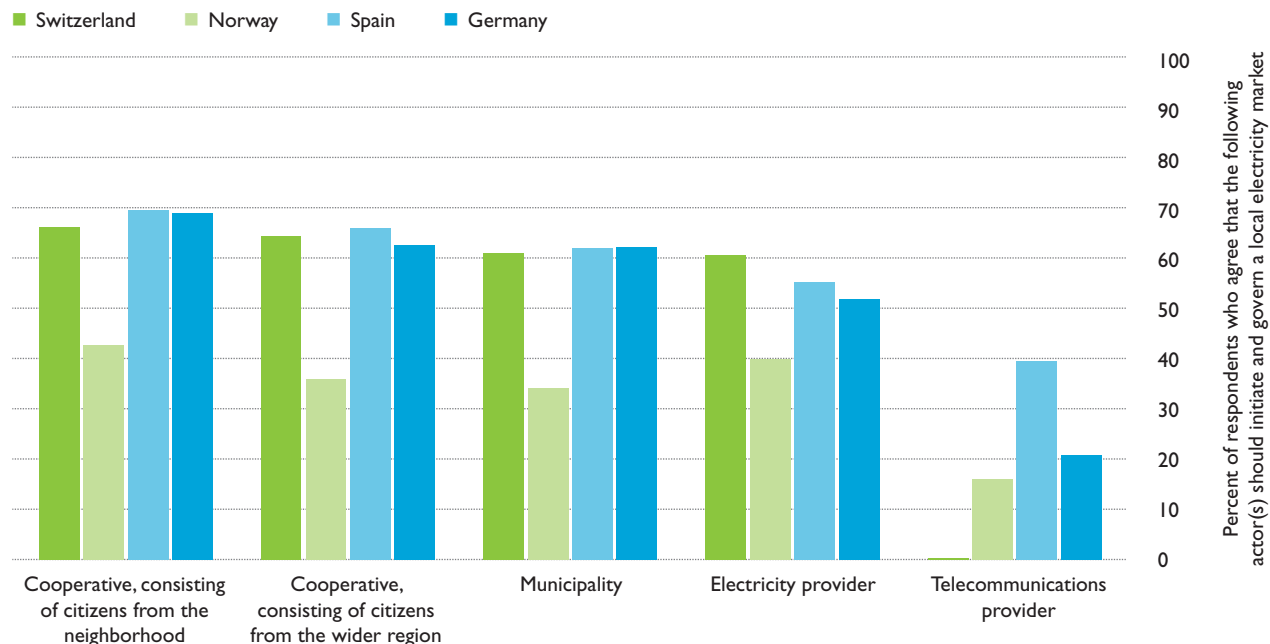


Key insights

- Among the list of potential services that was presented, respondents across all countries are most willing to pay for the installation and maintenance of solar panels/batteries, heat pumps (in Norway), smart technology (in Norway and Germany), as well as for the billing and account management of the excess electricity sold or shared.
- Respondents across all countries are less willing to pay for ancillary services and energy services (e.g. regular auditing of electricity consumption and production, information about energy consumption and production, integrated services for energy consumption & smart home), and for the management of financial investments in local electricity projects.

Governance Preferences for Local Electricity Markets

Approval by the following actors to initiate and govern local electricity markets



Key insights

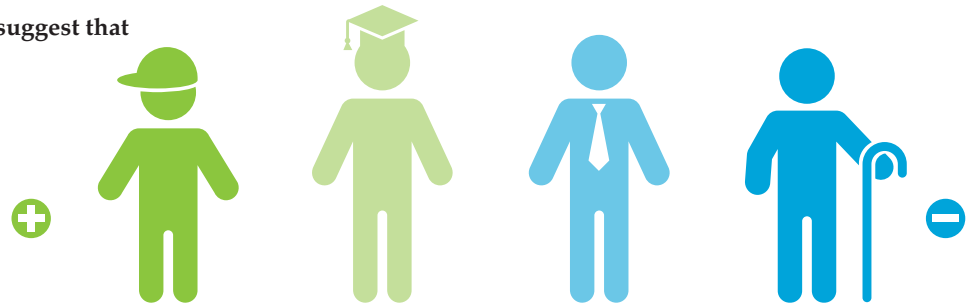
- The strongest endorsement was given to the idea that a cooperative, consisting of citizens from the neighborhood, should initiate and govern local energy markets.
- The second strongest endorsement for respondents from Switzerland and Spain was for cooperatives consisting of citizens from the wider region (64.3% and 66%, respectively); for respondents in Norway for the local electricity provider (39.8%), and in Germany for the municipality (62.2%).
- Respondents show the weakest preference for telecommunication providers to initiate and govern local energy markets.
- Overall, significant interest exists in the notion that a local electricity market should be governed and initiated by a cooperative model. While respondents exhibit general interest in cooperatives, they are less willing to contribute by volunteering or managing such a cooperative.

Demographic Aspects of Participants in Local Electricity Markets

Demographic characteristics

A number of demographic characteristics were investigated to identify attributes for segmenting potential future customers in local electricity markets. No significant differences were found with respect to gender, living area, ownership status or country of origin, and the prospective participation of respondents in local electricity markets.

Results suggest that



- Respondents' age predicts the likelihood that respondents imagine participating in a local electricity market, as well as the likelihood that respondents are interested in technological applications.
- The younger the respondents, the higher the likelihood that respondents can imagine participating in a local electricity market.
- A stronger tendency to participation can be observed for respondents in their 20s and 50s, and a stronger tendency for non-participation could be observed for respondents in their 30s and 70s and above.
- The younger the respondent, the higher the likelihood that they are interested in technological applications.

Technological applications comprise the following:



- Control of my electric devices via smart phone to reduce energy consumption.
- Control of my electric devices via smart phone to benefit from cheaper electricity tariffs.
- Remote control of household devices by the electricity provider to adjust offers and demands
- Better integration of solar energy into the network.
- More precise information about real electricity consumption and costs.
- Warning message and remote maintenance, if electric devices consume unusually large amounts of electricity.
- Comparison of electricity consumption with other households.
- Possibility to buy excess electricity produced by neighbors, if they do not use it.

Energy consciousness and energy knowledge

Energy consciousness describes the level of awareness, in terms of “a state of being alert and knowledgeable”, and a state of being aware of “what we do”, of “what we do not do”, and of “what we might have done” (Darby, 2006: 2931).

Results suggest that

- Energy consciousness tends to be higher, as age increases.
- The higher the energy consciousness, the higher the likelihood that respondents can imagine participating in a local electricity market.
- The higher the energy consciousness, the higher the likelihood that respondents are interested in technological applications.



Energy knowledge indicates the level of proficiency, skill and know-how, with respect to energy themes. Measurement is based on respondents’ self-assessment of their level of expertise, regarding energy-related themes. It is based on a 7-point Likert scale and on five items, as follows: (1) very low knowledge, (2) meet my personal needs, (3) adequately prepared for further education on the topic, (4) deep and broad knowledge base, (5) in the top one percent when it comes to energy-related themes/I am an expert. Energy knowledge is related to energy consciousness.

Results suggest that

- The higher the energy knowledge, the higher the likelihood that respondents can imagine participating in a local electricity market.

Technology status

The current technology status in respondents’ households predicts respondents’ prospective participation in local electricity markets. Technology status describes the number of energy-consuming devices that respondents have in their households (e.g. dishwasher, freezer, refrigerator, TV, computer, electric sauna, etc.).



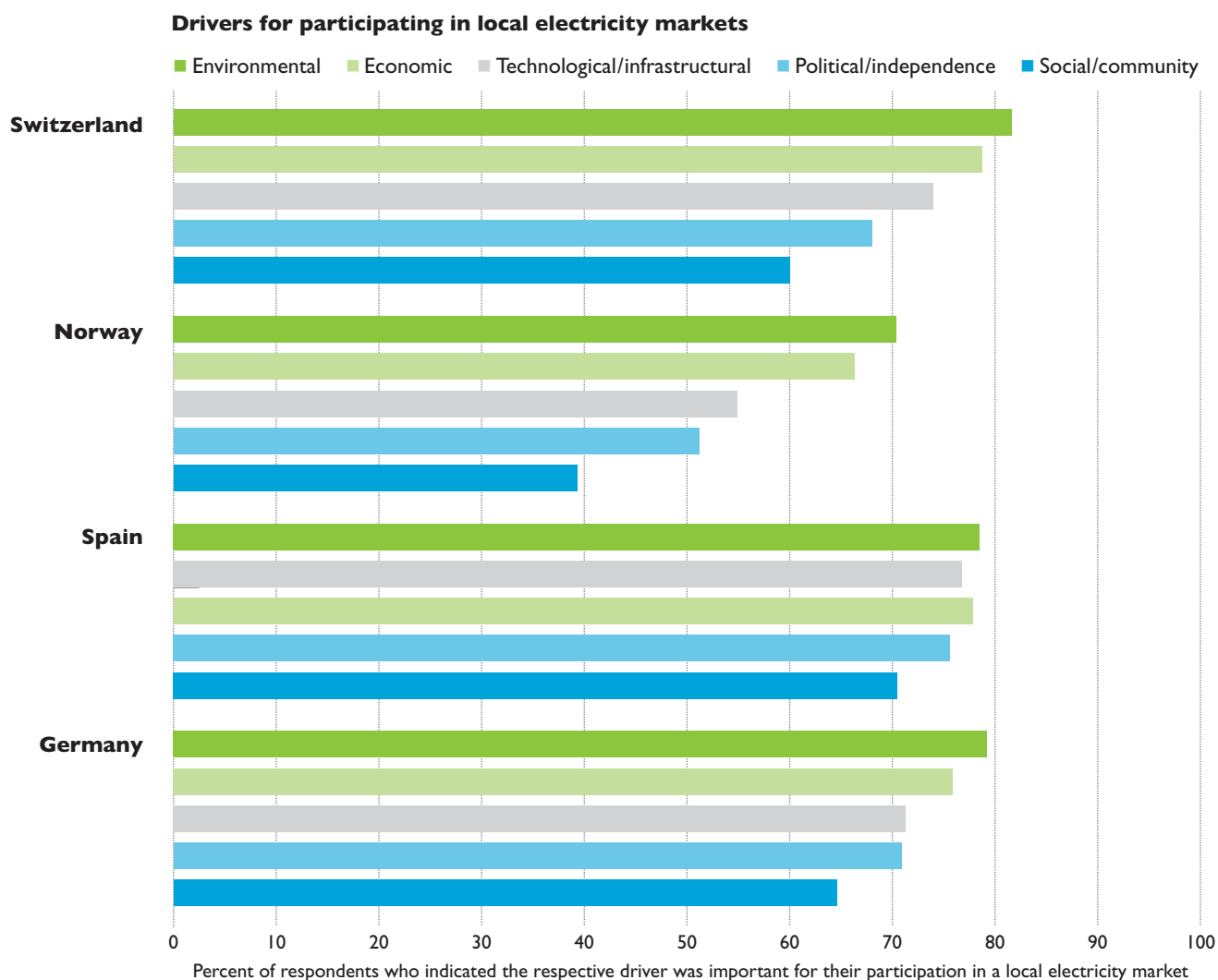
Results suggest that

- The more technological devices the household contains, the greater the likelihood that respondents can imagine participating in a local electricity market.
- The more technological devices the household contains, the higher the likelihood that respondents will be interested in technological applications.

■ These results were obtained through correlation analysis among selected variables across the total population (that is, irrespective of the country of origin).

■ Source: Darby, S. 2006. Social learning and public policy: Lessons from an energy-conscious village. *Energy Policy*, 34: 2929–2940.

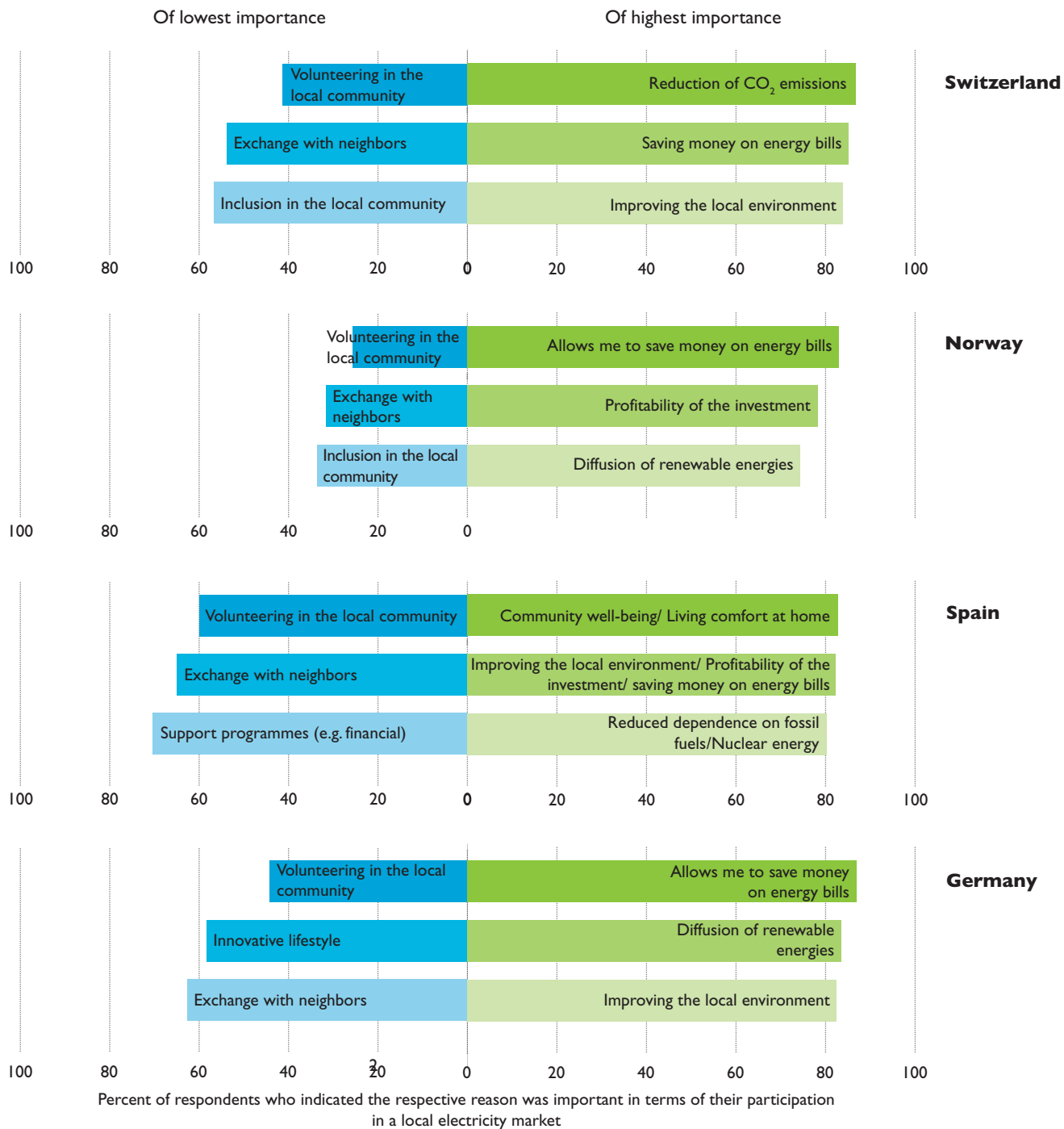
Reasons for Participation in Local Electricity Markets



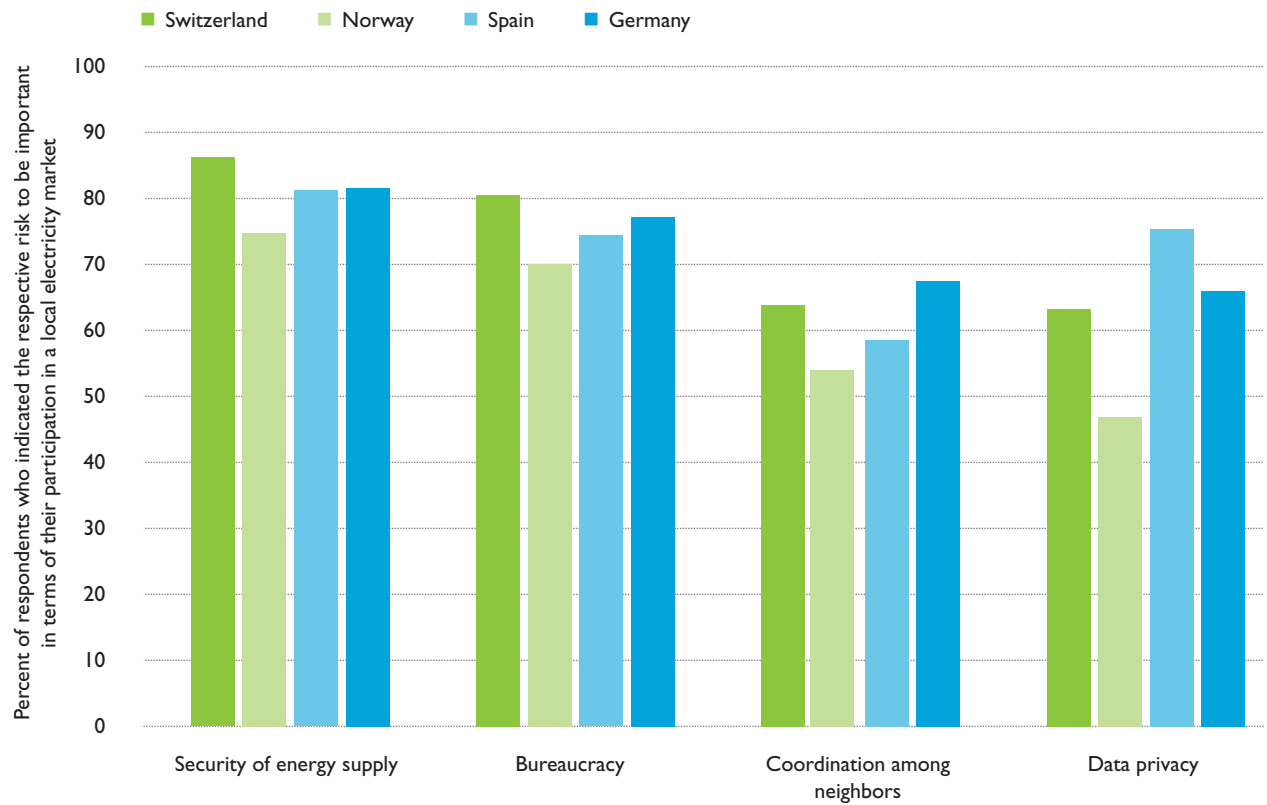
Key insights

- For respondents across all countries, environmental, economic, technological/infrastructural, political/independence are the most important considerations for participating or investing in local electricity markets.
- Environmental considerations incorporate, for instance, a desire to reduce carbon dioxide emissions, to lessen dependence on fossil fuels/nuclear energy, as well as to increase the diffusion of renewable energies and electric mobility.
- Economic considerations include, for instance, the possibility to save money on energy bills, the generation of additional income, the profitability of the investment, the increase in the value of an asset/house, the possibility to deduct the investment from taxes or granted incentives.
- Technological/infrastructural reasons cover contributions to the refurbishment of infrastructure, support for technological progress, enhanced living comfort and symbol of an innovative lifestyle.
- Political/independence grounds comprise support for the local community/neighborhood, support for regional development, reduced dependence on other regions and cities in the country, on energy imports from other countries, as well as the desire for independence from large corporations and from state organizations.
- Each of these aspects individually predicts the likelihood that respondents will participate in local electricity markets. They thus constitute the criteria for potential customer segmentation.

Most important/least important reasons for participating in local electricity markets



Priority risks for participating in local electricity markets

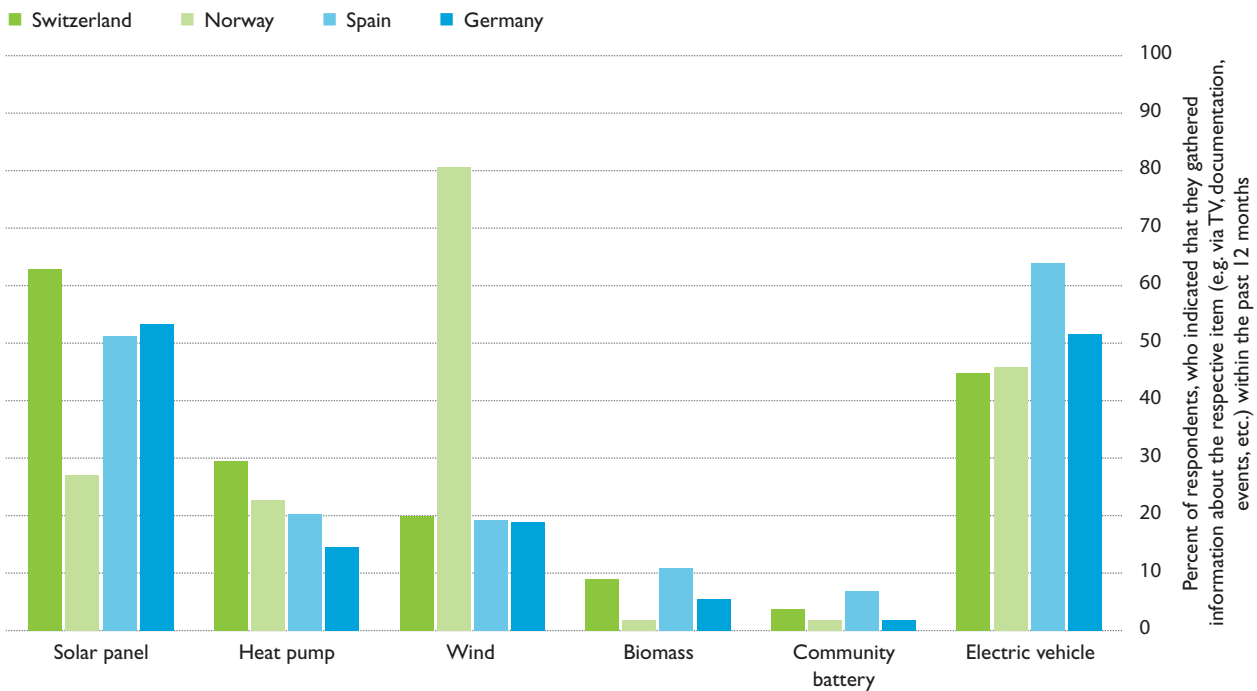


Key Insights

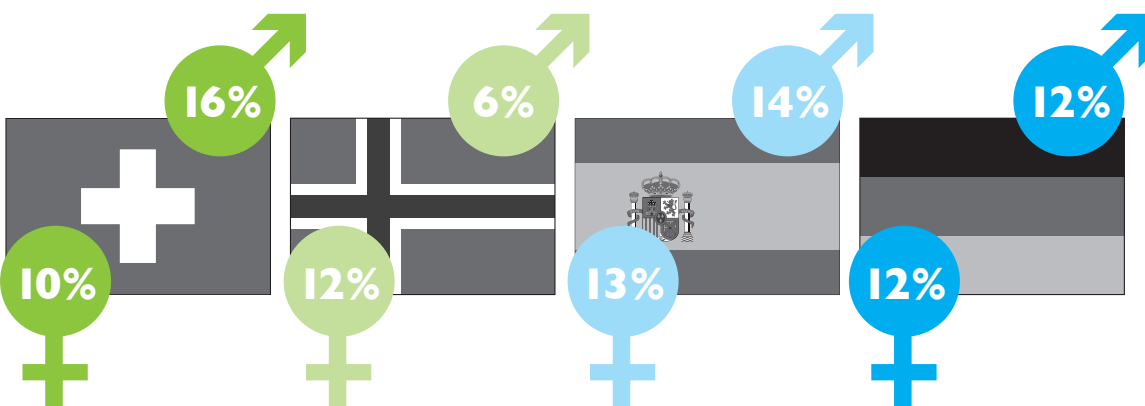
- Overall, the security of energy supply is the most important risk and bureaucracy (data privacy for respondents from Spain) is the second most important risk that respondents indicate.
- For respondents, who can imagine participating in a local electricity market, it is highly important that all these risks are avoided.
- In particular, the older the respondent, the more important it is for her/him to avoid bureaucracy in a local electricity market.
- Moreover, for respondents, who own a flat or a house, it is highly important that a local electricity market involves little coordination among neighbors.

Information Gathering

Respondents' information gathering by technology



Gender differences in information gathering

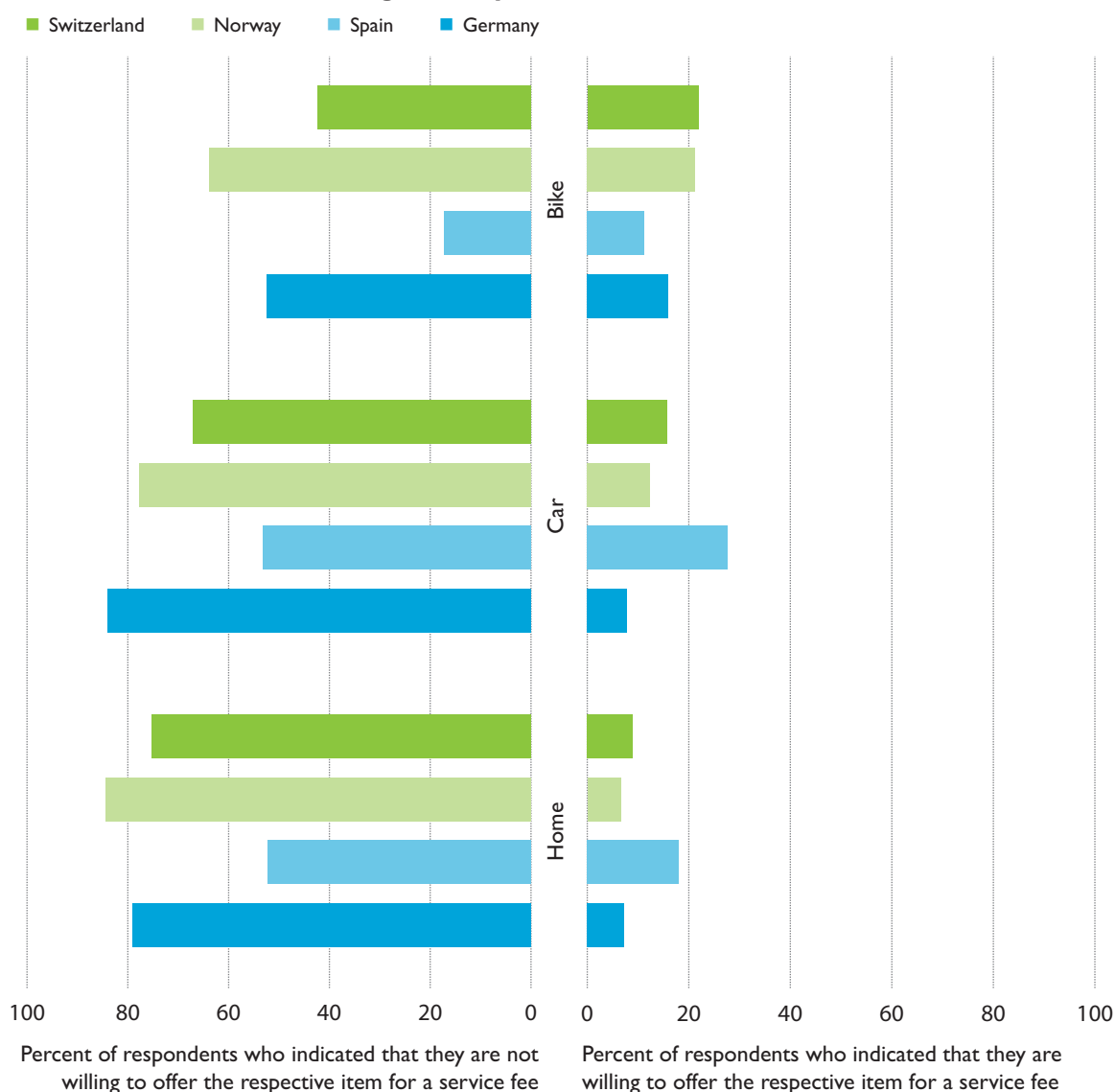


Key Insights

- Across countries, respondents gathered most information about solar panels and electric vehicles and to a lesser extent on heat pumps and wind.
- Electric vehicles are the most interesting theme for respondents from Spain, and Norway.
- Solar panels are the most interesting theme for respondents from Switzerland, and Germany.
- While information gathering appears to be equally distributed across men and women in most countries, in Norway, women gathered more information on the respective themes (particularly on electric vehicles, solar panels and heat pumps) than men; in Switzerland, men gathered more information (particularly on solar panels, electric vehicles, and heat pumps) than women.

Local Electricity Markets and Attitudes towards Sharing

General Attitude in the Sharing Economy



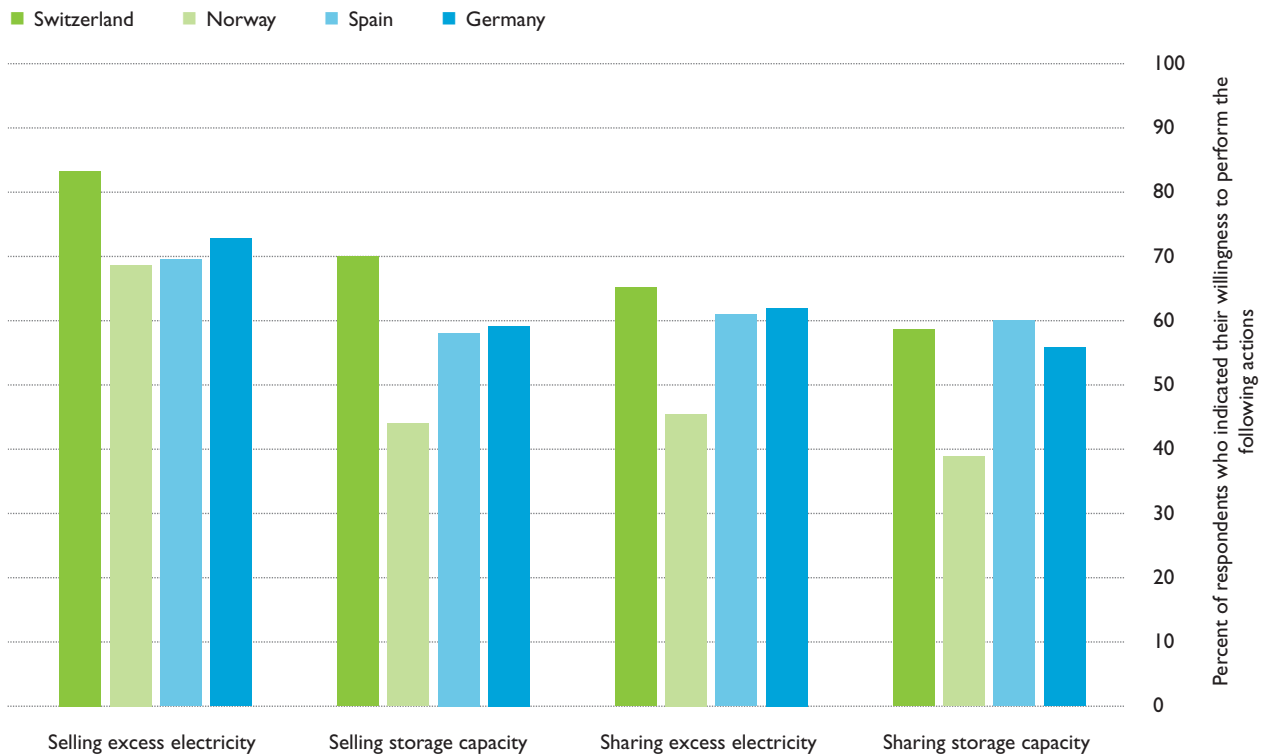
Key insights

- Overall, respondents' resistance to sharing private infrastructure is higher than their willingness to do so.
- Respondents' attitude towards offering private infrastructure for a service fee in the sharing economy is rather consistent across different items (particularly for bike, car and home).
- Respondents in Spain are more willing to share their car or home for a service fee than respondents in Switzerland, Germany and Norway.
- Respondents from Norway and Switzerland are slightly more willing to share their bike than their car or home.
- Respondents from Spain and from Switzerland are slightly more willing to use third party' accommodation than to offer their own home for a service fee (in Spain: 34% positive for using, compared to 18% positive for offering; in Switzerland: 17% positive for using, compared to 9% positive for offering).

Sharing or Selling Electricity or Storage Capacity

Stated priorities for participating in local electricity markets

Participation in local electricity markets can involve the marketing of excess electricity (that households have generated in excess of what they consume, for instance, through their own solar panels), or of storage capacity (that households dispose of via their household battery or electric vehicles). Participation in local electricity markets can involve selling (for a fee) or sharing (in the sense of peer-to-peer sharing), without a financial transaction, either excess electricity or storage capacity.

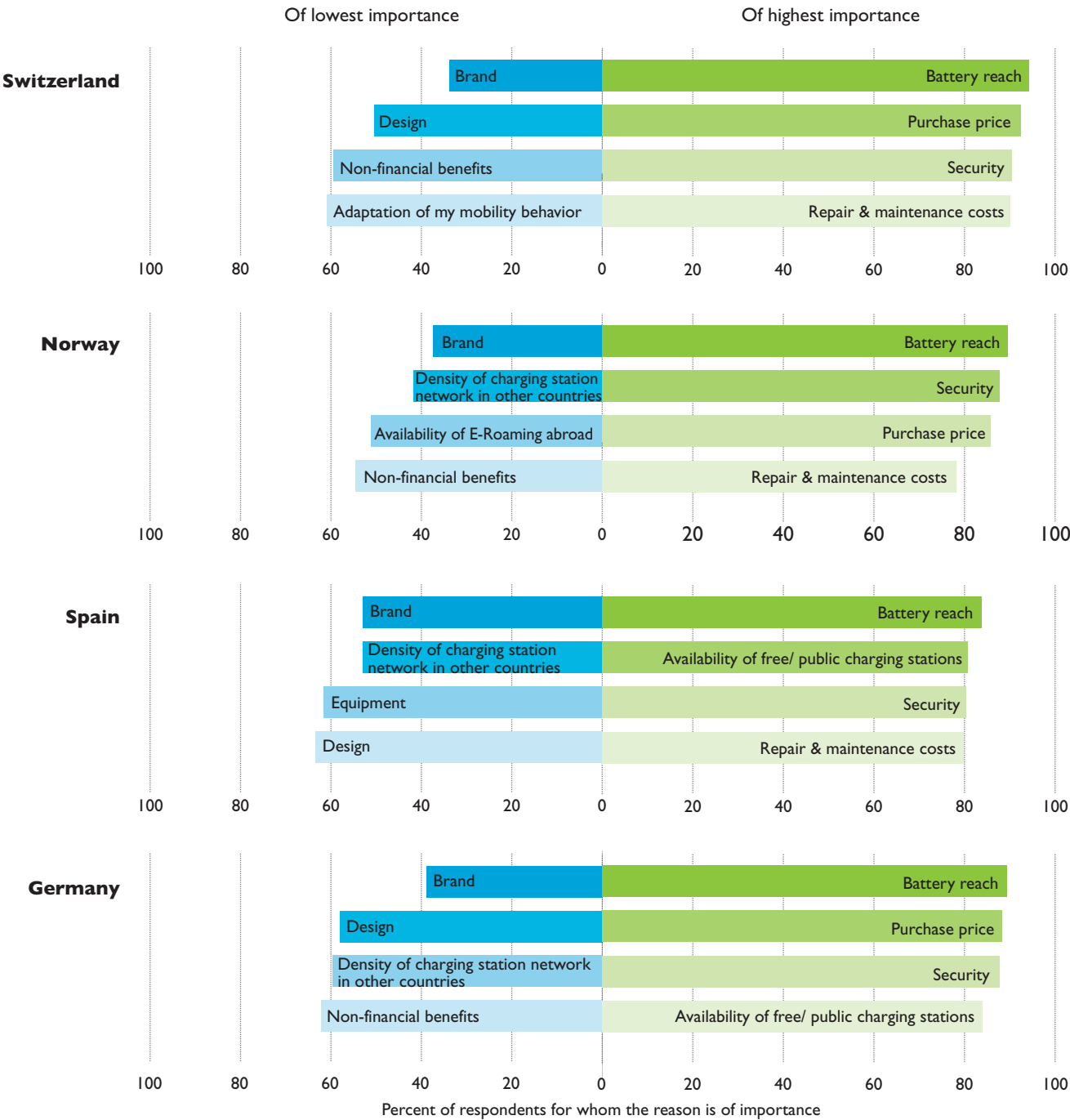


Key insights

- Overall, respondents are most willing to sell their excess electricity, compared to the alternatives.
- Overall, respondents exhibit lower willingness when it comes to sharing or selling storage capacity. That is, the opportunities that arise from their own storage capacity may be less evident to respondents.
- Respondents from Switzerland show a higher willingness to sell (rather than share), irrespective of whether the subject is electricity or storage.
- Respondents from Germany, and Spain show a higher willingness to participate with excess electricity (rather than storage capacity), irrespective of whether through selling or sharing it.

Adoption of Electric Vehicles

Importance of factors in purchasing an electric vehicle



Key Insights

- In local electricity markets, electric vehicles constitute one possible means, through which citizens can participate and offer storage capacity. They thus constitute a priority means of participation in local electricity markets. Uncovering the factors that drive or inhibit the adoption of electric vehicles is of central concern.
- Across all countries, respondents identify very similar factors that are important to them when buying an electric vehicle: Driving range, the price of the purchase, repair and maintenance costs, as well as security.
- Respondents from Spain and from Germany consider the availability of free/ public charging stations as important determinants in their decision whether to purchase an electric vehicle or not.
- Non-financial benefits (e.g. free parking, free use of bus lanes), particularly in Switzerland (59.5% of support), Norway (54.5%) and Germany (62.1%), are of lower priority to respondents.
- Potential buyers can imagine adapting their own mobility behavior (in Switzerland: 60.9%; in Norway: 69.7%; in Spain: 66.5%; in Germany: 64% of respondents can imagine such an adaptation).
- Overall, adoption rates may change as battery technology develops towards longer driving ranges, and as purchase prices fall (with decreasing battery costs and greater economies of scale).

A Note on Charging Infrastructure

- Overall and to all respondents, the density of the charging infrastructure in the home country is of great importance.
- In contrast, the density of charging station networks abroad, as well as E-Roaming abroad are among the lowest priorities.
- It is more important to respondents that the charging station network is dense in the home country, compared to the network abroad.
- It may thus be concluded, that for the time being, electric vehicles will be used rather for within-country travel.

Agenda for Action

Customer segmentation

- Citizen with a high technology status (that is, with extensive technological equipment) in the household, who are of younger age, and who have high energy knowledge/consciousness constitute client segments with the highest market potential for local electricity markets.
- Prospective customers may be more likely to participate with solar panels (particularly in Switzerland and Germany), smart technologies (particularly in Switzerland, Spain and Germany) and electric vehicles (particularly in Spain and Norway), than with heat pumps and wind technologies (except in Norway).

Priority agenda for action

- Target ideal-type customer segments: 1. interest in/ ownership of solar panels, 2. interest in/ ownership of electric vehicles, 3. interest in/ ownership of smart technologies, 4. interest in/ ownership of wind (for Norway).
- These ideal-type segments depend on the country of origin of prospective clients.
- Electric vehicles are among the most desirable technologies to customers. Yet, respondents appear to be less aware of the market potential of storage capacities. Sensitize and inform prospective customers about the market potential of storage capacity.
- To attract prospective customers with electric vehicles, inform and develop the density of the charging station networks in the home country, provide information about the security of electric vehicles, provide information about repair and maintenance costs over the vehicle lifecycle (repair and maintenance costs are generally lower for electric vehicles than for vehicles with internal combustion engines, according to AMAG, 2017).

Marketing strategy

- Prospective clients share pro-environmental, economic, technological/infrastructural and political/independence-related reasons for participating in local electricity markets.
- Prospective clients share risk concerns regarding the security of energy supply, bureaucracy, data privacy, and high levels of coordination among participants in local electricity markets.
- Both the energy knowledge/consciousness, and the technology affinity of the respondents tend to predict their willingness to participate in local electricity markets, as well as their interest in related technological applications.

Priority agenda for action

- Target marketing strategies at prospective customers by defining clear customer segments.
- Pro-environmental, economic, technological/infrastructural and political/independence arguments aimed at promoting local electricity markets should be included in any marketing strategy.
- Develop ideal-type marketing strategies that stress: 1. pro-environmental arguments, 2. economic arguments, 3. technology/infrastructure-related arguments, 4. political/independence arguments for participation.
- Marketing strategies should build on prospective clients' knowledge about energy, on their level of technology-related knowledge in general, or both, when outlining the specificities of local electricity markets.
- To seize novel market potential, marketing strategies should be designed, such that they inform and attract higher shares of females in Switzerland and of males in Norway for local electricity markets.
- The market potential of storage capacity should be highlighted (particularly in Germany and Spain).
- The local origin of electricity, as well as the benefits to the local community need to be highlighted, when promoting local electricity market.

Design

- In Switzerland, preferences for selling are stronger than preferences for sharing.
- In Germany and Spain, preferences for participating with electricity (rather than storage capacity), irrespective of whether it is sold or shared, are higher.
- Findings suggest that respondents from Spain and Switzerland may be more willing to use and consume products than to offer products or services in the sharing economy. The market efficiency and the balance between the number of buyers and sellers in the market may strongly vary across countries.

Priority agenda for action

- In Switzerland, platforms that enable sharing may be less highly adopted than platforms that allow for the selling of locally produced electricity. Local electricity markets should clearly differentiate from the existing “energy cooperative” models, by enabling real-time trading of electricity and storage capacity.
- The storage capacity of electric vehicles should become a critical element of local electricity markets.
- In Germany and Spain, the market for storage capacities may be less highly adopted, compared to Switzerland and Norway.
- Develop strategies to handle differences in the balance between the number of buyers and sellers in the market, when designing local electricity markets.
- Ensure high levels of digitalization in back-office processes to avoid high levels of bureaucracy and excessive coordination effort among participants.
- Innovative applications are particularly well-suited to attracting the attention of younger citizens for electricity markets and for electricity themes more generally. They are tools for fostering energy consciousness and energy knowledge in a playful manner.

Governance

- When designing the governance structure of local electricity markets, the local and neighborhood aspects (e.g. local origin of electricity; cooperative, governed by citizen in the neighborhood) is critical.

Priority agenda for action

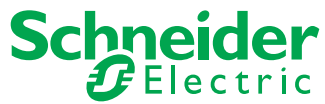
- Form cooperatives with local citizen (or citizens from the wider region) to initiate and govern a local electricity market.
- However, given that respondents are less willing to be actively involved in cooperatives, it is important to ensure the commitment of selected local citizens.
- Alternatively, allocate the governance to a third party. Platforms, like Airbnb and Uber, are good examples of such models in which buyers and sellers connect via a platform, that is hosted and governed by the founding company. Local electricity providers and municipalities are good candidates for taking over such roles.

Risks

- Security of energy supply should be guaranteed in local electricity markets.
- Bureaucracy and excessive coordination among participants should be avoided in a local electricity market.
- While data constitute a particularly valuable asset for the design of ancillary or personalized energy services, data privacy is of particularly high concern to respondents from Spain.

Priority agenda for action

- Local electricity market providers should cooperate with the local electricity provider to develop solutions for the potential lack of energy supply (e.g. insurance for energy supply, which may be charged at a premium).
- Digitalize back-office processes, such as billing, and account management, and relegate it under the control of a third-party service provider.
- Data privacy rules and regulations should be adapted to the local, national context. (Personalized) Ancillary services should be offered in line with customers’ privacy needs. Let participants consciously opt in for such services.



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